



Stocks and flows of natural and human-derived capital in ecosystem services



L. Jones^{a,*}, L. Norton^b, Z. Austin^{c,p}, A.L. Browne^{c,q}, D. Donovan^d, B.A. Emmett^a, Z.J. Grabowski^e, D.C. Howard^b, J.P.G. Jones^f, J.O. Kenter^{g,r}, W. Manley^h, C. Morrisⁱ, D.A. Robinson^a, C. Short^j, G.M. Siriwardena^k, C.J. Stevens^{c,l}, J. Storkey^m, R.D. Watersⁿ, G.F. Willis^o

^a Centre for Ecology and Hydrology (CEH-Bangor), Environment Centre Wales, Deiniol Road, Bangor LL57 2UW, UK

^b Centre for Ecology and Hydrology (CEH-Lancaster), Lancaster Environment Centre, Lancaster University, LA1 4YQ, UK

^c Lancaster Environment Centre, Lancaster University, LA1 4YQ, UK

^d Joint Nature Conservation Committee (JNCC), Monkstone House, City Road, Peterborough, Cambridgeshire PE1 1JY, UK

^e Pure Interactions UK, First Floor 2, Woodberry Grove, London N12 0DR, UK

^f School of Environment Natural Resources and Geography, Bangor University, Thoday Building, Deiniol Road, Bangor LL57 2UW, UK

^g University of Aberdeen, School of Biological Sciences, 23 St. Machar Drive, Aberdeen AB24 3UU, UK

^h The Royal Agricultural University, Tetbury Road, Cirencester GL7 6JS, UK

ⁱ University of Nottingham, University Park, Nottingham NG7 2RD, UK

^j Countryside and Community Research Institute, University of Gloucestershire, Oxstalls Lane, Longlevens, Gloucester GL2 9HW, UK

^k British Trust for Ornithology, The Nunnery, Thetford, Norfolk IP24 2PU, UK

^l The Open University, Walton Hall, Milton Keynes MK7 6AA, UK

^m Rothamsted Research, Harpenden, Hertfordshire AL5 2JQ, UK

ⁿ Natural England, Foss House, Kings Pool, 1-2 Peasholme Green, York YO1 7PX, UK

^o Campaign to Protect Rural England, 5-11 Lavington Street, London SE1 0NZ, UK

^p University of York, York YO10 5DD, UK

^q Geography/Sustainable Consumption Institute, The University of Manchester, M13 9PL, UK

^r Scottish Association for Marine Science (SAMS), Oban, Argyll PA37 1QA, UK

ARTICLE INFO

Article history:

Received 9 March 2015

Received in revised form 9 December 2015

Accepted 14 December 2015

Keywords:

Natural capital
Human capital
Scale
Sustainable
Beneficiaries
Potential service

ABSTRACT

There is growing interest in the role that natural capital plays in underpinning ecosystem services. Yet, there remain differences and inconsistencies in the conceptualisation of capital and ecosystem services and the role that humans play in their delivery. Using worked examples in a stocks and flows systems approach, we show that both natural capital (NC) and human-derived (produced, human, social, cultural, financial) capital (HDC) are necessary to create ecosystem services at many levels. HDC plays a role at three stages of ecosystem service delivery. Firstly, as essential elements of a combined social-ecological system to create a potential ecosystem service. Secondly, through the beneficiaries in shaping the demand for that service. Thirdly, in the form of additional capital required to realise the ecosystem service flow. We show that it is possible, although not always easy, to separately identify how these forms of capital contribute to ecosystem service flow. We discuss how applying a systems approach can help identify critical natural capital and critical human-derived capital to guide sustainable management of the stocks and flows of all forms of capital which underpin provision of multiple ecosystem services. The amount of realised ecosystem service can be managed in several ways: via the NC & HDC which govern the potential service, and via factors which govern both the demand from the beneficiaries, and the efficiency of use of the potential service by those beneficiaries.

© 2015 Published by Elsevier Ltd.

1. Introduction

Within the ecosystem services literature there is an emerging focus on natural capital (TEEB, 2013), the components of natural systems that underpin the delivery of ecosystem services. This is

* Corresponding author.

E-mail address: lj@ceh.ac.uk (L. Jones).

driven partly by concern at national and global scales that stocks of natural capital are being used at an unsustainable rate (Hails and Ormerod, 2013), and partly by the development of green accounting frameworks or the desire to separate the added value provided by human inputs from that contributed by the natural environment (UKNEA, 2011; Bateman et al., 2011; European Commission, 2012; Remme et al., 2014; Schröter et al., 2014a; UN, 2014). Yet, despite this focus, definitions of natural capital remain varied (e.g. Dickie et al., 2014). The role of human capital in the supply and delivery of ecosystem services is increasingly recognised (Tallis et al., 2012; Remme et al., 2014; Burkhard et al., 2014), and within the Ecosystem Approach humans are seen as part of an interactive holistic (socio-economic) system, where the welfare of humans and the health of the natural world are co-dependent (Raffaelli and White, 2013). However, uncertainty remains about the extent to which human capital contributes, and at which stages in the process of delivering ecosystem services it plays a role. If these concepts are to be useful for decision makers, they need to better integrate evidence on natural resource availability with an understanding of how society interacts with those resources (Olsson et al., 2004) in clearly defined ways.

In this paper we discuss two key issues in current thinking on the role of natural and human capital in delivering ecosystem services, and tie together emerging literature on these issues: (1) the conceptualisation of how ecosystem services are delivered; (2) the relative contribution of human and natural capital to ecosystem services delivery. We use examples of provisioning, regulating and cultural services delivered in multi-functional landscapes to illustrate a clarified understanding of ecosystem service delivery. Recognising that many stocks of capital are not being utilised or managed sustainably, we discuss the implications for better long-term management of stocks of natural and human capital. These ideas have arisen through discussions among a multi-disciplinary team involving natural scientists, social scientists, economists, NGO representatives, government policy makers and land managers.

2. Current issues

Most ES frameworks illustrate a linear-cyclic view where the environment provides a range of ecosystem services, from which humans obtain goods or benefits to which a value can be attached (e.g. MA, 2005; TEEB, 2010; Maes et al., 2013), with the role of natural capital more recently defined as underpinning ecosystem service delivery (TEEB, 2013). The cycle typically goes on to describe management feedbacks in response to human and other drivers of the system which in turn affect the natural environment (van Oudenhoven et al., 2012). In this paper, we explore particularly the part of this cycle concerned with generation or production of ecosystem services and the role of people in this process. We argue that portraying humans simply as users of natural capital or ecosystem services is an over-simplification impeding our conceptual understanding of how ecosystem services are delivered and, as a consequence, the management of ecosystem service delivery and associated stocks of natural capital. Two issues emerge from this discussion:

1) Although consensus is starting to emerge among the ecosystem services research community, there is a lack of clarity among many environmental scientists and policy makers in the conceptualisation of how ecosystem services are delivered. This applies to the majority of services, but perhaps more so in the case of cultural services for which typologies are still evolving (Daniel et al., 2012; Chan et al., 2012a,b; Brown, 2013; Church et al., 2014; Kenter et al., 2014). Many environmental scientists see ecosystem services purely from an ecosystem perspective, and

fail to appreciate that services are defined in the context of their use by humans. Meanwhile, the linkages which establish how ecosystems provide a service that is subsequently used by beneficiaries also remain poorly defined for the majority of services. This lack of clarity has hindered the development of integrated approaches to ecosystem service quantification and modelling.

2) While it is accepted that humans are part of the environment (Raffaelli and White, 2013), it is not always recognised that they perform multiple roles in an ecosystem services framework, e.g. as co-producers of ecosystem services, as beneficiaries of those services, and through the addition of capital to realise those services. Those roles are currently ill-defined. There is also a desire to separate out the natural capital and human capital elements of ecosystem service provision, driven by the needs of environmental asset accounting with its focus on natural capital (TEEB, 2010; Remme et al., 2014), and by a desire for economic valuation of goods and benefits (Boyd and Banzhaf, 2007). However, improvement is needed in identifying the range of components that go to make up a service, and distinguishing between the role of humans as beneficiaries of services, and their role in contributing to the service itself at multiple points along the ecological production function and the economic production function. Using a systems approach, we show that it is possible to separately identify how both natural and human-derived capital contribute to ecosystem service delivery for the three categories of final ecosystem services (sensu Fisher et al., 2008): provisioning, regulating and cultural.

There is increasing recognition that many stocks of natural capital are not being utilised or managed effectively, and their rate of use is not sustainable. At a global scale this rate of resource use may lead to exceedance of planetary boundaries (Steffen et al., 2015). At local scale unsustainable resource use has more immediate consequences for human wellbeing, along with equity issues in terms of access to ecosystem services, and may be a key consideration in evaluating trade-offs among ecosystem services in land management or policy decisions. Therefore, we explore how an improved understanding of how ecosystem services are produced, and the role of humans in that process can help guide sustainable management of these stocks into the future.

3. Issue 1. How are ecosystem services delivered: potential and realised services, the role of people as users of ecosystem services

The concept of ecosystem services is an acknowledged anthropocentric construct and their very definition centres on what the environment provides for humans (MA, 2005). Without users or beneficiaries (subsequently termed 'beneficiaries') the service does not exist. The way that this relationship between society, economy and nature is expressed in the ecosystem services construct is significant—for example riparian woodland may slow overland flow of water into streams, attenuating a flood peak, but if there is no community downstream which benefits from reduced flooding then that function does not constitute a flooding-regulation service within an ecosystem services framework. Schröter et al. (2014a) and Bagstad et al. (2014) provide good examples of this.

For a service to be realised therefore, there needs to be not only a set of products, functions or processes provided by the ecosystem but a corresponding set of beneficiaries which derive a service from them, illustrated simply in Fig. 1. This makes clear the distinction between what we call the 'potential ecosystem service' provided by the ecosystem, similar to what Tallis et al. (2012) describe as service 'supply' and Schröter et al. (2014a) and Villamagna et al. (2014) term 'capacity', and the service that is actually used by humans, that

Download English Version:

<https://daneshyari.com/en/article/6547443>

Download Persian Version:

<https://daneshyari.com/article/6547443>

[Daneshyari.com](https://daneshyari.com)